December 1961

EMO

NATIONAL DIGEST

Exercise Tocsin "B" 1961

Effects of Nuclear Weapons

Mutual Fire Aid

Industrial Preparedness

Fuel Supply Planning

EMERGENCY MEASURES ORGANIZATION

THE EMO NATIONAL DIGEST

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The EMO NATIONAL DIGEST is published bi-monthly to provide current information on a broad range of subjects dealing with civil emergency planning. The magazine is published in English and French and may be obtained by writing to the Emergency Measures Organization, Privy Council Office, East Block, Ottawa.

In addition to publishing articles which reflect Canadian Government policy the Digest may also publish articles by private individuals on subjects of current interest to the emergency measures programme. The views of these contributors are not necessarily subscribed to by the Federal Government.

Director: *R. B. Curry.* Editor: *A. B. Stirling.*

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1961

HIGHLIGHTS

In this, the final issue of volume 1, your attention is directed to the reproduction of the Prime Minister's, the Right Honourable John G. Diefenbaker's, address to the Nation which took place during the evening of November 9th over national television.

From the many requests received to reproduce the text of the Prime Minister's remarks there can be little doubt that an equal concern with emergency preparedness is shared by a great and steadily growing number of Canadians.

Exercise Tocsin "B" saw all three of the armed services join with representatives of every level of government in a massive test of the Nation's emergency plans. Photographs showing various scenes across the country during the exercise appear on page 2.

An article of particular interest in this issue is "The Effects of Nuclear Explosions" by Robert L. Corsbie. Long associated with the Atomic Energy Commission, Mr. Corsbie was also the senior member of the United States Strategic Bombing Survey Team which made a thorough examination of Hiroshima and Nagasaki following the end of World War II.

The fact that a large number of shelters are being constructed across Canada is substantiated by the hundreds of letters and telephone calls received every day by the federal E.M.O. information office. In the February issue the DIGEST will publish a photo story describing a 30 person underground fallout shelter recently constructed by a group of Ottawa families.

The Director and Staff of the Emergency Measures Organization join with the Editor in extending Season's Greetings to all DIGEST readers.

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Halifax, N.S., Nov. 22—There were frequent conferences between the Federal Government's regional commissioner and his principal staff officer at Exercise Tocsin B at Camp Debert, N.S. Here Edmund Morris, M.P. for Halifax is seen with J. G. Parsons, Regional EMO Officer. (*National Defence Photo*) 3-1.

In the Province of Manitoba Brigadier J. E. C. Pangman, Premier Duff Roblin and Gordon Chown, M.P. discuss details of Exercise Tocsin B.

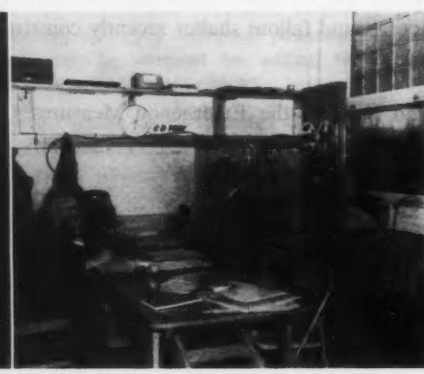
In the exercise CBC Studio at Penhold, Alta., Marcel Lambert, M.P. for Edmonton and Regional Commissioner for Tocsin B is interviewed by Alec Moir of the Canadian Broadcasting Corporation, while the Honourable L. C. Halmrast, Provincial Minister of Agriculture responsible for Emergency Measures in Alberta, and Brigadier J. S. Ross, Commander of the Army's Alberta Area, await their turn.

TOCSIN "B" 1961

Facing reporters at the federal headquarters during the Tocsin B press interview are: (*left to right*) Hon. G. E. Halpenny, M.P.; Hon. Raymond O'Hurley, M.P.; Hon. W. M. Hamilton, M.P.; Hon. D. S. Harkness, M.P., Air Marshal F. R. Miller; R. B. Bryce; R. Byrns Curry.

Mr. Walter Matthews, M.P. for Nanaimo and Federal Commissioner during Exercise Tocsin B being met at the Nanaimo Site by Brigadier J. W. Bishop, B.C. Area Commander. *Centre* is Mr. C. R. Boehm, Regional Officer for B.C. of the Emergency Measures Organization.

Provincial Nuclear Warning Centre, H.Q., N.B. Area. Closed cct TV Camera *top left*. John E. Swanton, Manager, N.B. Telephone Co. Ltd., *right*, and representatives of the company.



Emergency communications, Quebec Regional H.Q.

Brigadier J. W. Bishop, B.C. Area Commander greeting Admiral Finch-Noyes, Flag Officer Pacific Coast during a flying visit to Nanaimo as part of exercise Tocsin B.

ON THURSDAY, NOVEMBER 9th, THE RT. HONOURABLE JOHN G. DIEFENBAKER, PRIME MINISTER, SPOKE TO ALL CANADIANS OVER NATIONAL TELEVISION.

My fellow Canadians: I want to talk with you about the preparations being made to meet the emergency which would follow the outbreak of war, with special reference to the civil defence national exercises to be held next Monday and Tuesday.

I need not tell you that current international events cause deep concern to me and my colleagues in the Government who are charged with the responsibility of government. The Canadian Government will never cease in its efforts for disarmament and peace in freedom.

The constant search for peaceful solutions continues to be frustrated by an aggressive and adamantly unreasonable Soviet attitude. We try time and again by patient effort and negotiation to reach agreement over problems that divide the East and West.

While solutions to basic differences have not been attained, the outbreak of war has been prevented. However, there is ever present the awful possibility of a crisis developing into war. Each of us wants to believe that such a tragedy is remote, but stark reality compels even the most optimistic to face the fact that war is not as improbable as we should hope for.

In a nuclear war Canada, situated between the U.S.S.R. and the U.S.A., would be part of the battleground. We could undoubtedly suffer severe losses as the result of direct attacks upon Canadian targets, or because much of the air defence battle might take place over Canadian territory. Furthermore and in any case, Canadians will be exposed to the peril of radioactive fallout from attacks on targets in the United States.

I believe that even in the dire circumstances of nuclear war most Canadians could survive, providing that they take those preparatory measures in peacetime to protect them to a very real degree against the effects of nuclear weapons.

What can you and I do now which will be of individual and national benefit should war be launched by the U.S.S.R.? The British people in 1940 and 1941 saved many lives by organizing civilian defence and carrying it out courageously in the face of attacks. Although the dangers have been multiplied by nuclear power, we must strive to do as well.

You and I have a large degree of personal responsibility to take such measures of self-help that we can. Given the facts regarding nuclear attack, informed of the nature of the hazards to be faced, and instructed concerning the protective steps to be taken, we can do much to ensure survival.

Governments at all levels have a responsibility to do everything possible to further the individual's chances for survival. Comprehensive plans and arrangements are being made by the Federal Government, by each of the provincial governments, and by many hundreds of municipalities in Canada to help Canadians to survive.

Under nuclear attack it will be the vital obligation of government to aid individuals as fully as possible in their efforts to survive. To be in a position to do this, governments will have to disperse and decentralize so that they can operate effectively should the worst occur.

Manpower must be brought into action where it is most needed. All persons in the area of attack must be assured of a fair distribution of food, emergency accommodation and welfare services. There must be

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reasonably equal access to the needed medical and health services. Essential facilities such as transport and telecommunications must be equitably shared.

Governments must be prepared now to ensure that people, however dazed, hurt or desperate, are provided with their immediate survival requirements as quickly, as effectively and as fairly as possible. Only governments prepared and ready to act promptly throughout the nation can meet these needs and maintain law and order.

Every level of government must canvas carefully what its responsibilities will be in wartime emergency, what it can do in co-operation with other governments, and what it must do by itself. The Federal and provincial governments considered these matters fully in 1959 and the division of tasks has been determined.

While Federal and provincial governments can arrange the general character of emergency plans, municipal governments will have to carry out many aspects of the detailed planning required and take action in emergency. The wartime responsibilities of municipal government have been the subject matter of conferences and study courses with hundreds of mayors, aldermen and other local elected representatives. In consequence, the general nature of local governmental responsibilities in survival planning for Canadians is generally well understood.

Plans and diagrams, however well thought out, have to be tested. The only way to test emergency plans is through exercises that simulate and take into account the many aspects of a real attack. One such national exercise took place last May. Another, and more intensive exercise, is set for next Monday. It is designed to test existing plans and preparations and to locate any weak links in Civil Defence that may exist in planning or performance.

The exercise will start by an alert to be sounded (depending on the time zone) during late afternoon or early evening on Monday, the 13th of November. I ask you to listen to the radio, as soon as the alert has been sounded, for information as to steps to be taken. To guard against fear that an actual attack is taking place, frequent announcements to that effect will be made over the radio that the alert is an exercise.

As the exercise pattern develops, the conditions to be expected in nuclear war will be simulated with the assumed casualties and property damages, with resulting widespread disruption to normal living.

The focus of Federal government action will shift from the capital city of Ottawa, an obvious target for attack, to a small emergency headquarters at Petawawa which will be supported by dispersed units relocated in other areas. In each province there will be a regional emergency headquarters in which members of the provincial government will work alongside representatives of the Federal Government and the Army. In many hundreds of municipalities exercises will test their respective municipal emergency plans and preparations.

You will be asking yourself this question: "What part will I play as an individual?"

After the alert has been given by sirens or other suitable means, instruction and information will be given to you. As there will be no exercise in dispersal or evacuation and no one will be asked to move, your personal and family plans for a war emergency should be considered by you. In any case, you might properly determine to provide some protection against radioactive fallout by means of a shelter. If at a loss as to what you should do, information may be secured from the local Emergency Measures and Civil Defence organizations.

The pamphlet, "Eleven Steps to Survival", published by the Federal Government, is a very helpful summary of personal plans for the emergency. It is available free and a letter addressed to Box 10,000 in the capital city of your province will bring you a copy.

The safety of the children is a paramount care and concern. It is of them to whom my thoughts turn every waking hour of every day in the efforts being made by the Government in trying to maintain peace. It is natural to expect that the boys and girls will have many questions to ask when they hear the alert on Monday. They should be given the explanation as to the reason for and purpose of the exercises. Their lives and the lives of their parents and of Canadians everywhere can be saved if the advice contained in the pamphlet is followed.

I wish to ask for, and at the same time thank you in advance for your participation in this exercise.

I regret that this exercise has become necessary. We cannot and must not close our eyes to the dangers that may beset us. Failure on the part of government and of people to plan and to prepare for the awesome eventualities should nuclear war be launched, would be inexcusable—and worse. Just as insurance on homes and automobiles is taken out, hoping that the event against which we insure will not take place, so too in view of the world situation it is only prudent for us all to develop necessary plans and make the required preparations.

If war comes many lives will needlessly be lost if plans and preparations for survival are not ready. If war does not come, and the plans that we are making are never put to use, we have lost nothing but our time and energy in making prudent preparations.

I repeat the assurance that I gave at the beginning, that the Government of Canada will continue its relentless efforts to maintain peace—whatever the frustrations may be, and to bring about the settlement of disputes between nations by peaceful means.

The fullest devotion of Canada and the allied nations is being given to the preservation of peace in Freedom, but until assured we must do everything to safeguard the people against the awful possibilities should our efforts for peace not succeed.

* * *

THE EFFECTS OF NUCLEAR EXPLOSIONS

A statement by Robert L. Corsbie, Deputy Assistant Director for Civil Effects, United States Atomic Energy Commission. Made before the Civil Defence Hearings, House Committee on Government Operations.

IT IS the purpose of my remarks to cover briefly the effects of nuclear explosions, giving attention to those aspects which are of concern in discussions of defence against attack.

Beginning with weapons having an energy release equivalent to about 20,000 tons of TNT, technological efforts have produced weapons much smaller and many times larger. Thus one may speak of yield ranging from less than a kiloton, up through the tens and hundreds of kilotons, to the megaton and multi-megatons.

It is the opinion of many who have been associated with the development of technical information on nuclear weapons that the planning and establishment of protective measures proceed on a proper course only when appropriate consideration is given to all hazards. The requirements for complete defensive measures are based upon the knowledge of the combined effects.

It is convenient for illustrative purposes to speak in terms of a single detonation. Common sense tells us that we may be incautions to adopt a single detonation as an assumption upon which to base our plans. Although one weapon may be capable of destroying a target, several weapons may be used because of anticipated inaccuracies in placement or interference with delivery.

At the instant of a nuclear explosion an intense, brilliant light is emitted, the most brilliant light on earth. The light from low yield explosions has been seen at distances such as 400 miles during tests. The light from a megaton burst at high altitude over Johnston Island in 1958 was observed in Hawaii, over 700 miles away. The brilliant light identifies a nuclear explosion, as does the fireball. For the larger weapons the fireballs reach substantial size. For example 1 megaton burst produces a fireball with a maximum diameter a little less than one and one-half miles. Seen from a distance of 25 miles, this fireball would appear to have a diameter about six times that of the sun.

The explosion is accompanied by the emission of a highly energetic burst of nuclear radiation, principally the gamma rays and neutrons for our purposes. These radiations are far more penetrating than the gamma rays from fallout, but fortunately the range in the air is not as great as compared with blast and thermal radiation. For those concerned with the design of blast resistant shelters which will withstand the close-in effects, the initial radiation is very much to be considered. Thicker or more massive shields are required to attenuate the initial radiations than is the case with radiation from fallout.

About 35 per cent of the energy of an air burst is emitted as thermal radiation, much of it in the form of heat. The heat is sufficient to start fires and cause burns over large areas. It is an important casualty agent, particularly for megaton and multi-megaton explosions. The heat is radiated from low yield explosions during a very brief period. As the yield increases, the time is extended, although it is still a period of seconds during which the most hazardous emission occurs. It is proper to attempt evasive action to prevent burns if one is caught outside a shelter or in an exposed condition. Like the heat from the sun, the heat from a nuclear explosion can be attenuated by an opaque substance which will cast a shadow. Adequate shelter can provide satisfactory protection.

The interiors of shelters with open doors near points of detonation may become hot enough in high pressure regions to cause burns. In Japan burns were received by sheltered persons who could not be seen by the fireball. The phenomenon was also observed in biomedical shelter tests at the Nevada Test Site. The mechanism is not completely understood.

The light, nuclear radiation, and thermal radiation travel with velocities comparable to the speed of light. The blast, the last of the immediate effects, travels at lower speeds. Upon leaving the surface of the fireball, the blast wave is moving at many times the speed of sound, but it is slowed down as it progresses and soon degrades to approximately the speed of sound. A part of the energy released in the form of blast may be transmitted to the earth and produce ground shock. Its damage potential in the earth is much less than the damage potential of the blast in air.

The blast wave or shock is the source of physical damage from nuclear explosions. As would be expected, its destructive range is increased as the yield is increased; however it does not increase directly in proportion to the yield. As will be discussed later, blast is a producer of casualties through several mechanisms. Supplementing the damage caused by the overpressure and the blast winds, the blast is a source of secondary fires caused by damage to stoves and furnaces, breaks in electrical circuits and disruption of chemical and manufacturing processes.

It is particularly instructive to view the varia-

tions in the immediate effects which appear as the yield of the weapon varies. A chart has been prepared on which relationships are shown for nuclear explosions having yields of 1 kiloton, 20 kilotons, 1 megaton, 10 megatons and 20 megatons.

The three parameters selected for this description are the following;

For the effects of the thermal radiation—the heat—emitted by the fireball we use the range at which second degree burns will occur to the bare skin of exposed persons. Second degree burns are burns with blisters.

For the blast effects we shall use the range at which an overpressure of 5 pounds per square inch occurs. An overpressure of 5 pounds per square inch is sufficient to destroy conventional wooden and brick homes and inflict moderate to severe damage on brick apartment buildings. Blast induced injuries will occur in profusion at this pressure. I shall have more to say on the effects on personnel later.

For the initial ionizing radiation we shall use the range at which a dose of 700 rems will be delivered. A dose of 700 rems to the whole body can produce fatal radiation injury.

On the chart the circles represent the relative maximum sizes of the fireballs of the weapons. The fireballs are drawn to scale. The diameters range from a little less than 0.1 mile for the 1 kiloton air burst to about 4.6 miles for the 20 megaton air burst.

The bars depict the ranges to the second degree burn line, the 5 pounds per square inch line and the 700 rem line.

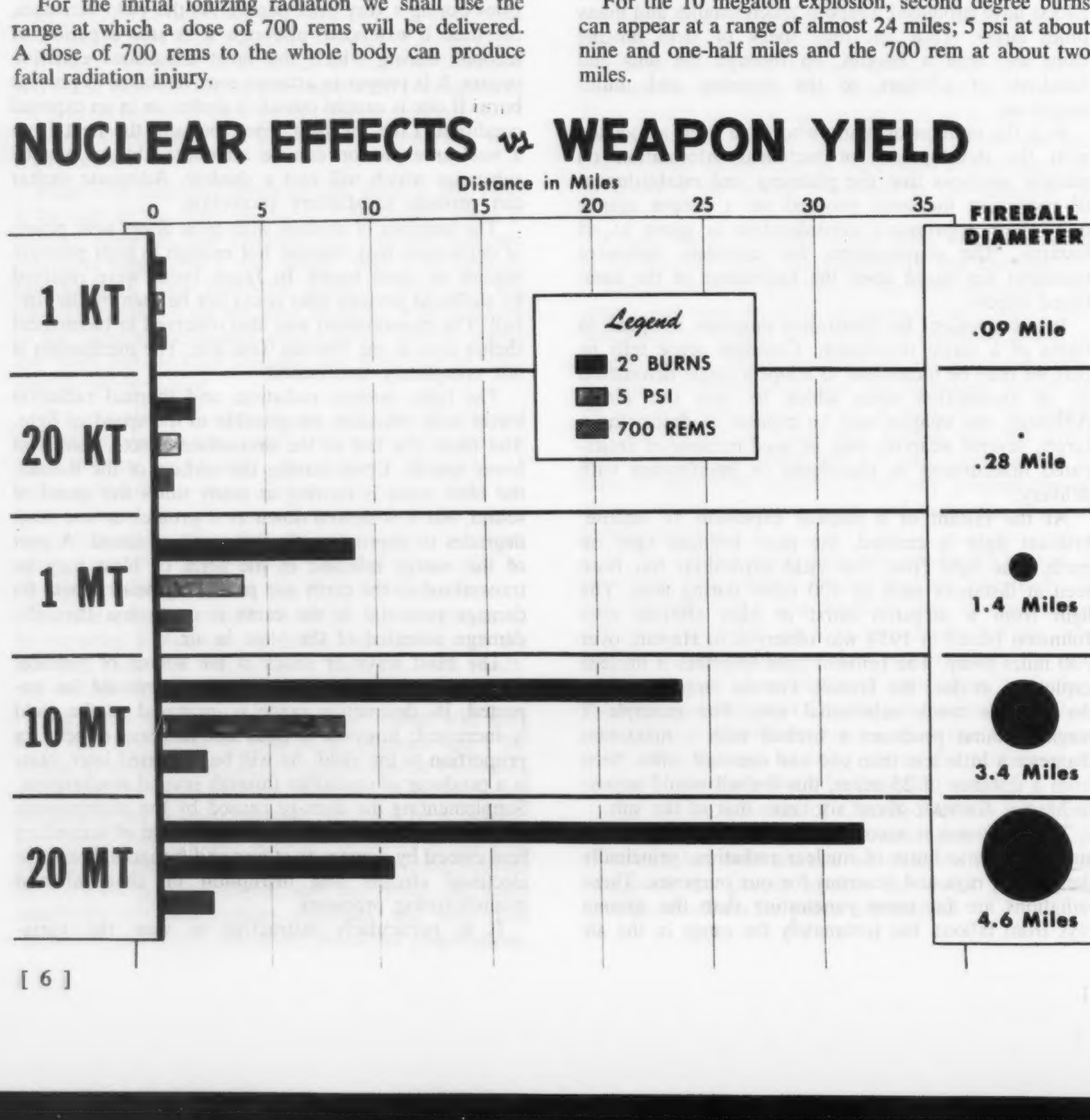
For the one kiloton air burst, you observe that the three levels appear at almost the same distance.

For the 20 kiloton air burst the levels are no longer about the same distance. The second degree burn line extends to 1.7 miles, while the 5 psi is at about 1.1 miles and the 700 rem is found at 0.7 mile.

For the 1 megaton explosion, the second degree burn range is at 9 miles, the 5 psi range is nearly four miles and the 700 rem is just under one and one-half miles. The serious burn area is many times larger than the serious blast area. The area subjected to heavy doses of initial ionizing radiation is relatively small.

For the 10 megaton explosion, second degree burns can appear at a range of almost 24 miles; 5 psi at about nine and one-half miles and the 700 rem at about two miles.

NUCLEAR EFFECTS vs. WEAPON YIELD



For the 20 megaton explosion, second degree burns can occur at about 32 miles, while the 5 psi range is 11 miles and the 700 rem range is about two and one-quarter miles. Over 3,000 square miles may be subjected to the hazard of at least second degree burns in the event of a 20 megaton explosion.

These are all the immediate effects. In a matter of a few seconds, and at the most a few minutes, they will have done their primary damage. The secondary fires may develop in from minutes to hours, as in Hiroshima and Nagasaki, and add to the difficulties of the situation. For the examples air bursts were used and no important fallout would be anticipated from air bursts. For surface bursts the ranges at which the effects would appear are decreased somewhat, but actually not enough to greatly ease the situation. The surface burst is the source of early fallout which is the principal delayed effect against which we must defend in nuclear war.

The fission reaction in nuclear weapons results in the creation of intensely radioactive elements which are called fission products. The radioactive material from megaton weapons used in war may contaminate hundreds and thousands of square miles to the point where the radiation may become a hazard to life.

The mechanism by which the radioactive fallout is produced and reaches the ground has been described in detail in reports, public booklets, films, the press and other media. Because of the amount of time and space devoted to the subject, fallout in nuclear war should be the nuclear hazard best understood by officials and the public.

In brief, a nuclear weapon, when detonated so that the fireball comes in contact with the surface, draws up a vast amount of earth. The earth is melted and mixed with the fission products in the process; and when the temperature drops, radioactive substances condense with the particles of earth. In a matter of minutes the particles will commence to fall toward the surface and be deposited in a rough circle around the point of detonation under the mushroom cloud and then downwind.

In the discussion of fallout it is convenient to consider it in two parts: early fallout and delayed fallout. Early fallout is defined as that which reaches the ground during the first 24 hours following a nuclear explosion. It is the early fallout from surface, subsurface and low air bursts that is capable of producing radioactive contamination over large areas with an intensity great enough to represent an immediate biological hazard.

The early fallout may be influenced by fractionization, which is a change in composition of the fission product mixture. The occurrence of the phenomenon is shown by the fact that the larger particles deposited near the point of detonation have radiological, physical and chemical properties different from those of the fine particles which leave the radioactive cloud later and are deposited farther downwind.

Delayed fallout, that arriving after the first 24 hours, consists of very fine, invisible particles that settle in low concentrations over a considerable portion of the earth's surface. The radiation from delayed fallout is greatly reduced in intensity as a result of radioactive decay during the relatively long time that the particles remain suspended in the atmosphere. Delayed fallout radiation generally poses no immediate danger to health, although there may be a long-term hazard.

As an illustrative device we are accustomed to discussing fallout patterns as rather smooth elliptical figures. In the Pacific and in Nevada the actual fallout patterns have been characteristically irregular and variable in distribution. For planning purposes we can make use of predictions, but for local, operational purposes there is no satisfactory substitute for measurements.

We should expect overlapping of fallout patterns from two or more detonations in a nuclear attack. There is every probability that an area contaminated by one explosion will receive more fallout from other explosions leading to a more serious situation. In preparing planning assumptions, conditions such as this must be treated; that is, conditions which occur because of the combination of effects from two or more weapons.

The second delayed effect is that of radiation from neutron-induced radioactivity. Some of the neutrons liberated by the reaction which produces the explosion escape from the environment of the bomb.

The neutrons have a capability of producing radioisotopes just as neutrons do in a reactor. There are present in the air and sea and in the ground elements which are susceptible to neutrons. Nitrogen and sodium are important elements, in this category; other examples are aluminum, silicon and manganese. Their radioisotopes have short half lives but can cause high initial activity; and hazardous dose rates may exist. Because of the short half lives, the decay progresses rapidly, more rapidly than in fallout.

In a war situation all the effects may not appear at a point in the order in which they have been discussed today, that is the order in which we would normally expect them at a test. An obvious departure would be the appearance of fallout *only* whether from one or more detonations. Another would be the arrival of fallout from a distant explosion followed some time later by the immediate effects—and possibly fallout—from a nearby explosion. But it is proper to remember that there are no known fallout casualties among the 220,000 Japanese hurt and killed in Hiroshima and Nagasaki. The conditions of burst influence the effects quantitatively. There is no single condition of burst which maximizes the severity or range of all the effects. An analysis has been prepared to show the variations which may be expected from different conditions of burst for weapons of similar energy yield. It deals with the light, heat, initial nuclear radiation, ground shock, air blast and early fallout.

For the high altitude burst the light is intense and the heat moderate, decreasing as the height of burst increases. There would be little initial nuclear radiation and airblast. Ground shock and fallout would be of little immediate concern.

For the air burst the light is intense, although less than for the high altitude burst. The heat is intense, as is the initial nuclear radiation. The range at which the heat is dangerous is much greater than the range at which the initial radiation is dangerous from the larger weapons. Except in the case of low air bursts, the ground shock is not a serious problem; air blast, on the other hand, is serious over a large area. The early fallout is negligible.

The surface or near surface burst is the source of the wartime fallout hazard. The light and heat from a surface burst, though less than the light and heat from the air burst, are considerable. The initial nuclear radiation is important, but less intense than from an air burst. Ground shock will be damaging to structures out to about three crater radii. The air blast effect will be greater at a close-in distance than would be the case with an air burst; however, the lower pressures do not extend to ranges at which they are significant for air burst weapons. Whether the weapon is detonated on the ground or on water, the severity of the effects are about he same, although there will be somewhat more light from the water surface burst.

The confined subsurface detonation where the surface, either of ground or water, is not penetrated produces no significant hazard except ground or water shock.

The chart on page 9 provides data on the "Relative Degrees of Weapons Effects for a Various Burst Conditions." The number of marks provides a rough indication on the relative importance of the indicated effect to the ground observer. Four marks imply that the effect is most extensive for the given type of burst; a blank space means that the effect is negligible or absent.

In the data on effects of nuclear weapons on personnel the numbers are in the main based on free field conditions. These are the sort of conditions which existed for many of the experiments conducted during weapons tests. The shock wave, for example, travelled across the test site generally unperturbed by structures. In a city the reaction of the blast with the buildings would produce local variation of turbulence and lower pressures.

The extent of injury and the rate of recovery, as we know, are related to one's orientation with respect to the effect, to the state of his health, to conditions in the environment and to the medical attention he receives. If an individual receives more than one type of injury, the future course of his health may be quite different and more complicated. For example, recovery from burns is impeded if the individual also receives a substantial radiation dose. While there is a desire for great precision in diagnosis of multiple injuries, the situations are complex, and we must settle for a somewhat less than complete forecast of injury.

The light from a nuclear explosion is dangerous to the human eyes at ranges of many miles in the event of bursts low in the atmosphere or on the surface, varying with visibility. At the test sites high density goggles were provided to the observers of nuclear tests, and there was an extensive warning system to prevent eye injury. Injury may range from a temporary flash blindness to burns on the retina. In the event of high altitude explosions of megaton bombs, that is, at 20 miles or so, the data for experiments during the tests above the Johnston Islands in 1958 show that burns to the retina can occur as far away as 300 nautical miles. In such high altitude explosions the light pulse is emitted very rapidly—much of it less than 0.015 second, the time required for the blinking of the eye. If one were looking the direction of a very high altitude burst, the injury would be produced before the blink reflex could react to protect the eye.

The second degree burn is not the only burn hazard. First degree burns of the bare skin of unprotected persons can occur over large areas which become increasingly large as the yield increases. First degree burns, comparable to sunburn, represent a non-incapacitating though uncomfortable injury. For air bursts in clear atmosphere first degree burns can occur as far as 13 miles from 1 megaton, 36 miles from 10 megaton and 49 miles from 20 megaton bursts. The need for warning of attack and for protective action thus extends far beyond the confines of what we may be apt to think of as a target.

If we can recover easily from first degree burns and accept them when necessary, we must be careful with the hazard of second degree and the more serious third degree burns. As stated, the second degree burn can occur about 32 miles from the 20 megaton bursts. At about 25 miles there would be sufficient thermal energy to produce third degree burns if no evasive action were taken. At still closer ranges sufficient heat would be delivered with such rapidity as to produce burns even with evasive action.

It has been estimated that 70 per cent of the Japanese survivors suffered mechanical injuries, that is injuries derived from the blast effects. Blast produces injuries in three ways. First there is the effect of the overpressure itself. Second there are the effects of missiles, such as fragments of glass, set in motion by the blast; and third, there is the displacement effect in which men may be injured by being set in motion by the blast and stopped or decelerated by impact with a hard object—a building, a tree, the ground.

The human body is quite tolerant to high pressures if we think of it as a pressure slowly applied without missiles or displacement. Survival of the blast effects would be common in regions having overpressures sufficient to damage severely all but especially constructed buildings if it were only a matter of overpressures, i.e., increases in atmospheric pressure or

RELATIVE DEGREE OF WEAPON EFFECTS FOR VARIOUS BURST CONDITIONS

BURST CONDITION	LIGHT THERMAL	HEAT RADIATION	INITIAL NUCLEAR RADIATION	GROUND OR WATER SHOCK	AIR BLAST	EARLY FALLOUT
HIGH ALTITUDE	■■■■	■■	■		■	
AIR	■■■	■■■■	■■■■■	■	■■■■	
GROUND SURFACE	■■	■■■	■■■	■■	■■■	■■■■
WATER SURFACE	■■■	■■■	■■■	■■	■■■	■■■■
CONFINED SUBSURFACE				■■■■		

primary blast. Indeed, among the survivors in Japan are those who were in buildings in the 30 to 40 pounds per square inch range.

Missiles, which is the designation used for pieces of flying debris, produce large numbers of seriously injured persons. Flying bits of glass can penetrate the body, and larger pieces of material—a brick, a timber, a piece of furniture—cause injury by striking the body a heavy blow.

If we were to assign a casualty producing value of *one* to the effect of overpressure, we should assign a value of *two* to the missile effect. And we should assign a value of *three* to the displacement effect.

It is the displacement effect—the decelerative impact—that causes many deaths and injuries in automobile accidents. During the 1957 tests we conducted an experiment in which anthropometric dummies were exposed to blast. A standing dummy exposed in an ideal pressure region to a maximum of 5.3 pounds per square inch was blown about 22 feet downwind; it reached a velocity of 21 feet per second, or 14 miles per hour, in one-half second after 9 feet of travel. A prone dummy at the same location did not move. A standing dummy exposed to 6.6 pounds per square inch in a non-ideal pressure region was displaced 256 feet down wind, veering 44 feet off course; a prone dummy at this position was displaced 125 feet downwind and veered 20 feet. At about 3 pounds per square inch pressure, for larger yields, displacement begins to become a major problem. At 3 psi the accompanying blast winds have speeds of the order of 100 miles per hour, which is about 25 miles per hour higher than an officially defined hurricane wind. We know how hurricane winds can move things and people. An incident overpressure of 5 psi will be accompanied by 160 miles per hour winds and 10 psi will have 290 miles per hour winds in a clean wave form. Although the concept of blast pressure is unfamiliar to many people, it becomes easier to understand when put in terms of the accompanying high velocity winds.

The ionizing radiations which accompany and may persist following nuclear explosions are well known for the ability to injure living things. For acute doses of penetrating radiation a report of the National Academy of Sciences-National Research Council has this to say "..., it can be stated with some confidence that total doses up to 150r to 200r, delivered acutely or over

Continued on page 13

COUNTY MUTUAL FIRE AID IN ONTARIO

Martin S. Hurst, Fire Marshal for the Province of Ontario and Chairman of the National Research Council Committee on National Fire Codes, has prepared the following article for the EMO National Digest.

THE words "mutual aid", which are in such common usage these days, are familiar terms to the fire service. Indeed if one reviews the history and traditions of the fire service it will be found that fire departments over the years have followed the principle of assisting one another to provide more efficient fire protection and fire-fighting facilities to the citizens of their communities.

As a major part of the Emergency Fire Services plans, the Office of the Ontario Fire Marshal developed an organization of County Mutual Fire Aid systems in 39 counties and one district in the Province of Ontario. These systems embrace 423 fire departments operating 675 self-propelled firepumpers and employing 9,128 fire-fighters. Last year there were 36 instances where County Mutual Fire Aid was activated, involving 17 County Mutual Fire Aid systems. In each case the potentially serious fire was kept to reasonable proportions.

The first step to organize these province-wide pre-planned systems was taken in 1951 with the first system functioning early in 1952. The objects of the program are twofold:

(i) To develop a system whereby a fire department may obtain assistance of other fire departments under a pre-arranged plan in the event of a serious conflagration occurring in its municipality.

(ii) To provide an efficient province-wide fire service mobilizing organization as part of the provincial preparedness program for any national emergency.

The concept of County Mutual Fire Aid (CMFA) is relatively simple. However, sometimes it is confused with other methods of fire protection services. In Ontario it simply means that the councils of two or more municipalities that support fire protection services formally express by bylaw their permission for their fire departments to assist one another on a reciprocal aid basis in the event of any major conflagration within the defined limits of their fire areas under a pre-arranged plan and under the direction of a County Fire Co-ordinator.

Mutual Fire Aid is authorized in Ontario under the Municipal Act and operates for both peacetime and national emergency purposes. It does not function for the every-day fire such as under hire fire protection, but only for the large emergency fire which is beyond the capabilities of a single fire department to handle within its own resources. Municipalities participating in mutual aid are required to have sufficient apparatus and manpower to provide the every-day fire protection to the area they service.

Use of geographical boundaries of a county provide an efficient and workable size operational area. There are several advantages to this method: a county not only provides geographical boundary lines but also political boundary lines and a unit of local government which may become necessary in future developments of these systems.

Currently, county councils have no specific authority or responsibilities in these plans. However, the members who represent various municipal councils within the county are directly concerned.

In addition to geographical boundaries an operational-administrative head is necessary. The policy, which has worked out quite well, is to appoint the chief of the largest fire department within each county a District Deputy Fire Marshal to act as County Fire Co-ordinator. The appointment is made with the concurrence of the chief's municipal council by Provincial Government Order-in-Council under the provisions of the Fire Marshals Act.

An important and essential feature of these appointments is that the County Fire Co-ordinator, who is the mobilizing head of the CMFA systems, has a department which is manned 24 hours a day and therefore can provide the mobilizing personnel which is required for the efficient operation of the systems.

To make CMFA schemes effective, obviously fire departments must be able to work together. This means for example that all fire departments should be using a standard fire hose thread. Some six years ago the hose thread standardization program was completed in Ontario at a cost of one million four hundred thousand dollars which now permits the use of fire hose couplings and allied fittings between any fire departments in the Province. Prior to standardization there were 103 different threads in the Province and as many as three different threads in one municipality.

As part of the standardization program a substantial amount of fittings and adapters are located at strategic Ontario-U.S. state and other province border crossing points. This means efficient mutual aid on a county basis with neighbouring states and provinces.

For each county plan a county running card assignment is prepared and posted in the fire stations of each participating fire department which gives the automatic response and cover-ups of all the fire departments in the county to any emergency in either peace or war. The running cards which are prepared by the Fire Marshal's Office, according to a standard format, list the apparatus, equipment and manpower of each department.

In Ontario, the Workmen's Compensation Act provides for coverage of all full-time and volunteer fire-fighters both operating in their home municipality and any other municipality. Therefore, special liability coverage for fire-fighters in this program is not required. However, as some municipalities provide liability coverage for their fire apparatus on the basis of operating only within the limits of their fire area, there are some instances where this liability coverage has to be extended to provide coverage for the apparatus while operating in these county systems outside their fire areas.

In our opinion, the success and progress of CMFA programs in Ontario are to a substantial degree due to the excellent acceptance by fire departments and municipal councils. The programs are based on sound fire department operational procedures which have been in effect in large fire departments for many years.

There are side developments of the program which we think are important. Their effects may not entirely be appreciated for some years though. The Canadian Underwriters' Association has given official credit in all its surveys of municipalities in counties where Mutual Fire Aid systems are organized.

Nine counties are now developing county short-wave radio networks for the dispatch of fire apparatus and their control in the field.

Another development is the organization of CMFA associations in each county which has CMFA systems in operation. This is of paramount assistance in developing mutual aid efficiently. These associations provide a meeting ground for fire chiefs and fire-fighters to periodically discuss fire protection and fire prevention problems and to work out solutions for the common good of everyone. As a result of these association meetings, some counties are now promoting county-wide fire prevention programs and others are organizing first-aid classes under the sponsorship of the St. John Ambulance Association.

Prior to the establishment of the Ontario Fire College, the Fire Marshal's Office development and conducted County Fire Instructors' Courses as an outgrowth of CMFA discussions and recommendations at association meetings. The courses provided a standard system of training throughout the Province. A substantial portion of time was devoted to the techniques of instruction and over 400 experienced fire-fighters were trained in twenty-two, 60-hour courses. The object was to provide a group of instructors skilled to carry out a standard fire training program within their own departments and to train any civil defence auxiliary fire-fighters who may be recruited. This course is now conducted as an 80-hour course at the Ontario Fire College.

I should underline that the organization of CMFA is not the final answer to the problems involved in organizing fire departments to operate under nuclear attack conditions. However, we believe these county systems are essential as a preliminary step to train manpower and to use existing apparatus in the event of a national emergency.

The exact system of establishing CMFA as functioning in Ontario may not be feasible in other Canadian provinces where there is no such county unit of government. However, the same principles can be applied to develop area CMFA systems—providing there is the appropriate provincial legislation for municipalities with fire departments to enter into agreements to assist one another, and adequate compensation coverage for the fire-fighter while operating outside the limits of his municipality.

In any Emergency Measures effort the fire services assume primary importance, not only in combatting fire but also because they are existing organizations with long experience in disaster operations. The fire services are in fact Emergency Measures Organizations in being. As currently constituted, they are expected to do everything possible to control the spread of fires from bombing attacks, but there remains a problem: *It is essential that we have greater resources of trained manpower and special equipment and complete co-ordination of our fire services for any expected large scale operation.*

* * *

Miss Evelyn A. Pepper, nursing consultant, Emergency Health Services Division, Department of National Health and Welfare, has been honoured for her contributions to medical health and disaster preparedness. She was presented with the Pfizer Award of Merit at the 10th annual conference of the United States Civil Defence Council held in Los Angeles, California. Miss Pepper is responsible for planning and implementing educational programmes for professional and volunteer nurses to meet emergencies. Miss Pepper, a graduate of the Ottawa Civic Hospital School of Nursing, served in England, Holland and Italy during World War II.

INDUSTRIAL PREPAREDNESS

On October 20th, 1961, R. B. Curry addressed the Canadian Industrial Preparedness Association at Trenton, Ontario. The following article is a condensation of that address.

THE problems which industry must consider in planning for a national emergency are not unlike the problems of government. I suggest that they can be divided into the following areas:

(1) Continuity of Management
(2) Protection of Plant and Equipment
(3) Protection of Personnel
(4) Safety of Essential Records

The above are not arranged in order of importance. The protection of personnel is of the utmost importance. These same areas are of prime concern to government in making its plans against nuclear war.

While I would not wish to draw the analogy too closely between industry and government, it would seem that in the matter of continuity of management the following matters should be considered:

(*a*) The planning of appropriate succession lists for persons in management so that in the event of casualties it would be known who would succeed those lost.

(*b*) The necessary legal measures to be taken in advance so that continuity can be more readily assured.

(*c*) The possible provision of emergency headquarters, perhaps in a branch or at a point removed from the greater peril of direct attack. From these headquarters management could carry on in an emergency.

(*d*) A warning system and an appropriate internal communications system to be provided so that key personnel could be withdrawn in time to ensure that the function of management would continue.

(*e*) Emergency financial arrangements might be provided in advance since problems in this area are likely to be of critical importance in an emergency.

(*f*) Industry might well follow the example of government in putting some people of first-class ability at work fulltime in developing emergency preparations. They should be supported by an advisory committee on emergency planning drawn from all the important divisions of the industry in question.

In addition, there are problems regarding the protection of plant and equipment which are worthy of careful consideration. There is the matter of the protection against possible sabotage which may become very important in wartime, and there is also the problem of emergency shutdown, particularly in plants whose type of operation makes shutdown extremely difficult. Provisions must also be considered for standby power, for fuel and for water supplies, on all of which industrial production is so completely dependant. Fires which result from nuclear attack direct attention to the advisability of developing fire brigades with special training to meet these perils.

Another consideration is the matter of dispersal of spare parts and of key duplicate machine tools so that the essential elements of production can be reconstituted, if possible, soon after attack. Arrangements should also be made in existing plants, and particularly in new plants, for layout of equipment which will give the greatest inherent protection against damage to the most vital items of such equipment.

In industrial preparedness there is no matter more important than that of personnel protection. Whether the area in which the plant exists comes under direct attack or whether it is subject to the perils of radioactive fallout, or even if it escapes all such perils, there are many things that can be done which will better ensure the preservation of the personnel concerned. There is need for increased emphasis in first aid training. There is the matter of the training of rescue teams, which can be vitally important, and there is room for improvement in fire fighting techniques which can pay rich dividends.

Personnel can be canvassed with respect to their plans for their own families in the event of nuclear war, and arrangements can be made to provide rendezvous points where personnel can reassemble if the plant has been damaged or contaminated and its manpower scattered.

Industry must give some thought to the possibility of employing single persons to carry out vital requirements in case plants have to shut down and a mere holding force is required to carry on essential processes or maintenance, even under threat of attack. All plans for protection of industrial personnel must be related to local and municipal plans. These may involve dispersal or certain measures of voluntary evacuation and they should certainly involve provision of shelters in one form or another.

Each plant, particularly in the more likely target areas, should survey the degree of protection that is provided in the plant structure itself. Generally, industry should know what fallout protection is in existence now in its various plants. They should know what cost would be involved in bringing such protection up to desirable standards and in particular they

should consider whether or not they could provide proper fallout protection in all new construction. In these questions they can be aided materially by the pioneering surveys made by the federal Department of Public Works. These surveys will assist in determining the inherent protection against fallout in existing larger buildings and in calculating the probable costs involved in bringing such protection up to required standards.

Another matter of intense concern to industry in the event of nuclear attack is the safeguarding of essential records. Among these records are the arrangements for succession of management to which I have referred earlier; vital legal documents, pay lists, superannuation lists and other records of greatest concern with respect to personnel.

Then there are financial records and records of technical character, including all matters bearing on the production capacities of the business; records of inventory, and many others which will not escape the attention of those assigned to give consideration to this important subject.

Undoubtedly, under the challenge of nuclear attack and the problems that would be with us in its aftermath, the flexibility of industry will be of extreme importance. It may be necessary for plants to produce items quite different from those normal to them. While plowshares have at times to be beaten into swords for the conduct of war, conversely, swords have to be turned into plowshares in the days that follow.

One is confident that the imagination and capabilities shown by industry in World War II will prevail again if need be. The challenges, however, will undoubtedly be much more pressing and the time limits will be far tighter than ever before. The essential problem that Canadians will face is a stark and simple one—how to survive and how to recover.

However, apart from the preparations and plans which industry should make to protect itself and its people against the perils of possible nuclear war, occasions exist today which challenge the imagination and flexibility of industry. There is a growing demand for supplies and services which are not readily available. For example, cheaper materials for fallout shelter construction are urgently required. Also badly needed are ingenious adaptations with plastic, fibreglass, plywood, metal shapes and other materials that lend themselves to the requirements of these unorthodox structures.

Numerous other items are also required, such as: inexpensive transistors for radio communication with people in shelters, simple kerosene operated stoves for shelter use, cheaper blast valves for those who construct shelters designed to give protection against the effects of nuclear blast. There is a need for reliable, and if possible, inexpensive radiac instruments to measure the intensity of fallout and to calculate its accumulated effect.

Small generating equipment of simple design is urgently required and there is a particular need for easily assembled, long lasting and reasonably inexpensive emergency food supplies.

The items mentioned above represent, perhaps, a cross-section of the hundreds of enquiries received by the Emergency Measures Organization from Canadians in every part of Canada. There is a great and new awareness across the country of the dangers which threaten, an awareness which has resulted in a demand for these emergency supplies. And industry should meet the challenge now.

The survival of Canadians in the holocaust of a nuclear war is a matter of intense concern to all. It concerns federal and provincial governments, who must determine the general framework within which detailed plans can be formulated, but it particularly concerns local government.

Just as people and government at all levels are involved in this most complex and challenging matter, so also is industry involved for only through the combined efforts of government, industry and citizens can this country be prepared for any eventuality.

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days or months, would result in no apparent acute effects and serious late effects in only a small percent of those exposed." When the dose gets larger the clinical symptoms increase. A small percentage of the people receiving doses between 200 and 300r might need hospitalization; most of those receiving doses between 300 and 400r would need hospitalization; and all of those receiving doses over 400r would need hospitalization. The LD 50 is often given at 450r; that is, 50 percent of the people receiving that much of a dose would not be expected to recover. The LD 50 concept is widely used, and I sometimes believe it may be interpreted as "either you're dead or you're not." Actually the 50 percent who survive will be very ill and their recovery will be slow.

Although acute 150 to 200r doses will result in no acute effects in the great majority of people, this is not to be construed as a license for indiscriminate exposure until the dose has been accumulated. The values do give a means for making some assumptions with respect to feasible and economical shielding against radiation. They also point out the departure from the conservative peace-time standards which would be unuseable in wartime and very likely for many years thereafter.

When we look at maps and diagrams of fallout patterns on which dose rates at various times are shown, we often see 1,000r/hr and other high levels indicated. After a couple of weeks the 1,000r/hr at H plus 1 hour will have fallen to 1r/hr or something in that neighborhood. The fact that the dose rate at two weeks is smaller by a factor of 1000 does not mean that a dose rate of 1r/hr is nothing to worry about. Careful

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EMERGENCY FUEL SUPPLY PLANNING IN ONTARIO

The following article has been prepared for the E.M.O. National Digest by Mr. A. H. Morris, Emergency Measures Office, Department of Energy Resources, Ontario.

Introduction

Six areas in Ontario have been designated as potential targets for nuclear attack if Canada were to become involved in a nuclear war:

(1) Hamilton-Burlington	(4) Niagara Peninsula
(2) Toronto	(5) Ottawa
(3) Windsor	(6) London

Excluding Ottawa these areas involve nearly 5 million people, and the problems of feeding, medical care and shelter that would result from a nuclear attack would be enormous. But, Ontario is faced with an added burden—that of supplying essential fuels for homes and industry.

A report of Ontario Department of Energy Resources entitled "Origin of Ontario's Energy Supply" concludes that the Province produces only 12 percent of its energy requirements. For the balance, Ontario depends heavily on other sources, as much as 45 per cent from outside Canada (chiefly the United States) and 43 per cent from other provinces.

Over the last few years, because of tremendous population and industrial growth, Ontario has changed from a wood and coal burning province to a complex fuel economy with highly specialized and competitive fuel supply industries. Today, petroleum and its products provide over 53 per cent of the energy consumed (gasoline and other petroleum transport fuels account for 20 per cent of the overall total); coal is next, providing 28 per cent; electricity supplies 11 per cent; and natural gas, a relative newcomer, accounts for approximately 8 per cent. These figures, although taken from the aforementioned Department of Energy Resources report for the year 1959, should be relatively the same for the current year.

It is evident from the above that if the supply and distribution of petroleum and its products could be safeguarded through the shock and the rehabilitation period of an atomic attack, then the Province's fuel and transport requirements would be substantially provided for.

Crude Oil Supply

Ontario at the present time has seven operating refineries, three in the Toronto-Hamilton area, three in the Sarnia area and one with a small daily thruput at Fort William. These refineries require approximately 250,000 barrels of crude oil per day. Since Ontario produces only about 1 per cent of its crude oil requirements there is virtually no indigenous supply. Ninety-five per cent of all crude oil used by Ontario refineries is supplied by Interprovincial Pipeline entering the Province from Western Canada at Sarnia.

If this pipeline were damaged or destroyed, the Ontario refineries could continue operating at their normal peacetime rate for about twenty (20) days, using crude oil stocks held at the refineries.

During the remainder of the Shock Phase and possibly during the early part of the rehabilitation period, alternative methods of supply would have to be found. Crude oil transfers by water, rail and the feasibility of using product pipelines are all being considered by our planners.

Petroleum Product Distribution

The next step in the supply of petroleum products is the movement from the refinery to the next level of distribution which includes jobbers, distributors and wholesalers who operate land or marine bulk storage terminals, as well as direct refinery shipment to large consumers. The groups that make up this link in the distribution chain are entirely dependent upon transport in one form or another. The quantities involved indicate the enormity of the transport machinery required. In 1959 Ontario consumed 104,968,000 barrels of refined petroleum products, of which 31,445,000 barrels were imported from other provinces and foreign sources. Nearly 50 per cent or 15,445,000 barrels were brought in by pipeline from Quebec and 7,700,000 barrels from the same province by tank-car, truck transport and ship. Manitoba supplied some 100,000 barrels to the Head of the Lakes area. Foreign sources provided approximately 8,200,000 barrels by boat, tank-car and pipeline.

The final phase to be considered is the retail distribution of petroleum products. It is estimated that there are approximately 15,000 gasoline stations and fuel oil dealers located in the Province. The role that these establishments would play in an emergency would be vital and therefore deserves careful planning. The location of all service stations and fuel dealers must be mapped and known within certain specified areas, such as in cities, larger towns and certain counties. The pattern of supply including routes and methods is known and alternate routes can be worked out.

In planning for the distribution of petroleum products, it is necessary to have as detailed a knowledge as

possible of the location, normal holdings and type of product at all bulk terminals throughout the province. With this information, distribution patterns can be developed, and additional storage facilities planned for, and so provide for the needs of the industrial, commercial and residential users following a nuclear attack.

Coal Supply

At the present time, in spite of a declining trend, coal is the second most important fuel in Ontario. In 1959 coal consumption accounted for 28 per cent of the total energy consumed in the Province. The fact that Ontario has no coal deposits of her own becomes a very stark fact when considered in the light of a national emergency.

There are 60 vessels registered in coal service with a combined capacity of approximately 388,000 tons presently operating in the Great Lakes. The majority of these ships are American owned. Only 17 are under Canadian registry and these have a total capacity of about 71,500 tons. Since 27,600 tons of water-borne coal is required per day, it is evident that Ontario would be sadly lacking in coal cargo vessels if the United States ships were required for emergency purposes to service strictly American requirements. This is not only apparent in the case of Ontario, but there is a growing awareness in the United States of a possible shortage of Lake boats. At a recent meeting of the Great Lakes Commission, Admiral Lyndon Spencer presented a criticism of the present federal (U.S.) policy governing the depreciation of the investment in new construction of lake vessels and proposed the establishment of a reserve fleet of Great Lakes vessels in the interest of national security.

An analysis of coal consumption in Canada, which will be most helpful to planning authorities, is contained in a recent report by the Dominion Coal Board entitled "Coal and Energy in Canada Since the War". Ontario is divided into six areas and the amount consumed in each area is established. Using these areas as starting points this method could be refined further, and each area broken down to pinpoint the major cities' and larger towns' consumption of coal.

Any plans that entail coal for emergency use should take cognizance of the present day position of the manufacturers of coal-burning equipment. Large industries, generally speaking, are in a strategic fuel position, they are usually adapted to burn more than one fuel—to take advantage of changes in the market prices of fuel. Commercial and residential consumers as a rule are dependent upon one type of fuel. A review of DBS figures on the subject indicates a considerable shortage of manufacturing capability to supply Ontario with coal-burning equipment. The manufacturers of oil and gas equipment might be able to alleviate this situation but to what extent only an extensive survey would reveal.

Natural Gas Supply

In October 1958, the construction of the Trans-Canada pipeline was completed in Ontario, an accomplishment which was to change considerably the overall fuel picture in the Province. Natural gas companies operating in Ontario had been dependent upon imports from the United States to augment domestic production up to this time.

In 1960 total sales amounted to approximately 105 billion cubic feet. On a theoretical daily basis this consumption would approximate 287,670 M cubic feet per day, of which Ontario production would account for about 19 per cent, U.S. imports for 13 per cent and the balance from Western Canada.

Ontario's natural gas production was in the neighbourhood of 18 billion cubic feet for the year 1960. The average cold weather monthly production rate for Ontario gas fields amounted to 2.2 billion cubic feet per month or 76 million cubic feet per day. At this rate and assuming that Trans-Canada pipeline is out of operation and supplies are not forthcoming from the United States, then a strict rationing system would have to be effected in order to extend gas production from Ontario wells as long as possible for essential industrial, commercial and residential consumption.

However, there is another aspect that shouldn't be overlooked and that is the natural gas storage capabilities that exist in Southwestern Ontario. At the present time, there are five gas storage pools located in the townships of Dawn, Sombra and Moore in Lambton County which are owned and operated by a subsidiary of the Union Gas Company.

The normal operation of these underground reservoirs is to pipe in gas during the low demand summer months for use in the winter period when demands reach a peak. A recent analysis of the storage pools total capacity, indicates that if it all could be withdrawn, Ontario's needs would be met for approximately 90 days at the present rate. However, it is evident that decreasing pressures will occur once the basic "pressure-cushion" quantity is reached with a corresponding decrease in deliverability. This point of diminishing return would be reached in approximately 60 days.

Propane Supply

After this supply has been exhausted what can be done about substitute energy needs for the homeowner, the apartment dweller and the commercial and industrial establishments? One fuel that would have particular merit in these circumstances is Liquified Petroleum Gas (propane). Although certain orifice and control changes might have to be made, the switch-over would be less involved than converting gas burning units to other fuels.

An important factor for consideration is the propane supply picture. At the present time L.P. Gas used in Ontario is mainly a product of petroleum refinery operation, both domestic and import, but this situation

is rapidly changing. It is estimated that in 1961 or 1962 the production of L.P. Gas as a by-product of natural gas in Western Canada will reach 100,000 barrels per day from some 46 processing plants. Twenty-six plants are now in operation producing 34,000 barrels per day and 20 additional plants are in the blueprint stage.

Electric Power Supply

Although Ontario has a deficit of petroleum, natural gas and coal, the situation is reversed when it comes to electric power. In 1959, Ontario produced or generated approximately 94 per cent of the amount available for consumption and obtained the balance of her requirements from Quebec.

Hydro-power site development in Ontario has almost reached the point of complete exploitation with the construction of the St. Lawrence Seaway project. It has been estimated that power produced from falling water will decrease from 78 per cent to 48 per cent in the space of the next 10 years. This, of course, would increase Ontario's dependency upon fuel sources originating outside of the Province, except for the possibilities of power from native uranium.

The transmission of power techniques that are developing are perhaps more important from a security point of view than the generation developments. One of the most significant of these is the power-pool system, whereby all the power generated in the province is brought into one central pool and tied into similar pools existing in other provinces such as Manitoba and Quebec. The idea is extended now to the United States and pools of several northern border states are tied into the Ontario power system. This allows the rapid transfer of electricity from one area to another to meet increased demands as they are forecast or an emergency.

Another promising technique is the extra-high voltage principle, or EHV as it is called. This is the movement of power in large blocks at much higher line voltages than previously used and will permit economic transfer of power over much greater distances thus utilizing remote generating sites.

Conclusion

This is a very brief outline of Ontario's position with respect to the four principal energy components. With the exception of electric power, the province depends to a large extent on the importation of fuels from other provinces and the United States to supply its energy needs.

For this reason, the Department of Energy Resources appreciates that Ontario's very survival depends on detailed peacetime planning to ensure that adequate energy fuels are available to meet essential survival needs following a nuclear attack.

To this end many of us in the Department are devoting our full-time efforts, and we hope at a later date to report through the *EMO National Digest* on the development of some of our plans.

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guidance from local officials and radiological know-how on the part of individuals and families will be required to minimize the effects of radiation.

Next I wish to add a few words about physical damage. Shelter from the weather would be important to us in wartime just as it is in peacetime, and we depend on a variety of building, facilities and equipment.

Inside the range at which 30 psi would occur we should expect to find complete destruction of buildings except those which are specially constructed. Out to the 5 psi line and perhaps somewhat beyond in the event of megaton bursts we should expect to find wooden and brick homes destroyed. Above-ground tanks and commercial and communication facilities will be severely damaged in the 5 to 10 psi range.

Underground pipelines are quite well protected; however, the service connections are usually inflexible, and breaks can be expected to occur in profusion at the points where service lines enter buildings. Severe blast damage to automobiles occurs in the 5-7 psi range.

Superimposed upon the blast damage or compounding it will be damage from fires. Under certain conditions small fires become mass fires which consume all combustible materials. The annual fire loss exceeds $1 billion now when conditions permit fire to be fought with skill; the prospects in wartime give cause for deep concern.

I have a few observations pertaining to protection in a general way.

If there is to be a nationwide effort, then the knowledge and skills present in cities and towns all across the nation must be applied. There are data ready for practical applications in the hands of the professional people in architects' and engineers' offices, safety engineers, building developers, city engineering offices, and others who work in materials and design. They are the same people who are responsible for the engineering and design of physical structures today.

These data say, for example, that it is possible to design a one storey wood rambler house which will provide as much shelter in the basement against fallout as we now find in a conventional two story house. By substituting a concrete floor slab 6 to 8 inches thick with a ¾-inch hardwood finished floor glued to it, for the usual wood beam construction, we may achieve a result equally pleasing in appearance to the homeowner, yet it improves considerably the protection against fallout. The windows in basements can be eliminated; we put them there before we had electricity to light and ventilate basements. We can use smooth roofs which will not hold the fallout particles. And we can exercise more care in using brittle, friable materials which convert under low pressure to damaging missiles. * * *

11 STEPS TO SURVIVAL

- **Know the effects of nuclear explosions.**
- **Know the facts about radioactive fallout.**
- **Know the warning signals and have a battery-powered radio.**
- **Have some shelter to go to.**
- **Have fourteen-days emergency supplies.**
- **Know how to prevent and fight fires.**
- **Know first aid and home nursing.**
- **Know emergency cleanliness.**
- **Know how to get rid of radioactive dust.**
- **Know your municipal emergency plans.**
- **Have a plan for your family (and if you are alone, have your own plan.)**

For a copy of the booklet "11 STEPS TO SURVIVAL" write to your local or provincial civil defence co-ordinators.

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R. B. Bryce

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